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(12) # EUROPEAN PATENT APPLICATION

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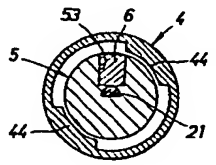
(54) **Centrifugal clutch.**

(57) A centrifugal clutch comprises a clutch drum (4) loosely rotated relative to a rotary drive shaft (21) and provided with large inner diameter portions (43) and engaging protuberances (44) inwardly projecting from the large inner diameter portions (43); a clutch body (5) loosely fitted within the clutch drum (4), admitting insertion and fitting of the rotary drive shaft (21) to be driven by the rotary drive shaft (21), and provided with a retaining hole (53) opening radially from the centre thereof toward the inner wall of the clutch drum (4); and an engaging permanent magnet (6) loosely movably retained in the retaining hole (53) of the clutch body. When the clutch body (5) is in a standstill state, the engaging permanent magnet (6) exerts its magnetic attraction onto the rotary drive shaft (21) and thereby is accommodated within the retaining hole (53). When the clutch body (5) continues its rotation, centrifugal force is generated. The centrifugal force allows the engaging permanent magnet (6) to protrude from the retaining hole (53), come into contact with the slide on the inner wall of the clutch drum (4) and engage with one of the engaging protuberances (44) of the clutch drum (4).

FIG. 4



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DESCRIPTION

The present invention relates to a centrifugal clutch capable of connecting or disconnecting the relation in rotation between a driving shaft and a driven shaft by utilisation of a permanent magnet.

There have heretofore been proposed clutches having centrifugal force exerted on a spring, those making use of magnetism of an exciting coil, etc. However, these clutches are complicated in construction, entail a disadvantage from an economical point of view and prevent the advancement of productivity.

In view of the drawbacks of the conventional clutches as described above, the present invention has been accomplished.

An object of the present invention is to provide a centrifugal clutch which is simple in construction, capable of reducing the number of the component parts, excellent in durability, inexpensive in manufacturing cost and operable with high precision.

According to the present invention, there is provided a centrifugal clutch comprising a clutch drum loosely rotated relative to a rotary drive shaft which serves as a magnetic substance, and provided with large inner diameter portions and engaging protuberances inwardly protruding from the large inner diameter portions; a clutch body loosely fitted within the clutch drum, driven by the rotary

drive shaft fitted therein, and provided with a retaining hole radially opening toward the inner wall of the clutch drum; and a permanent magnet loosely movably retained in the retaining hole, accommodated within the retaining hole by magnetic attraction of the permanent magnet to the rotary drive shaft at the time the clutch body is in a standstill state and, at the time the clutch body is in a driven state, caused to protrude toward the inner wall of the clutch drum by means of the centrifugal force and engage with one of the engaging protuberances.

Following is a description by way of example only and with reference to the accompanying drawings of a clutch of carrying the invention into effect.

In the drawings:-

Figure 1 is a plan view illustrating application of one embodiment of a centrifugal clutch according to the present invention to an actuator,

Figure 2 is a cross-sectional view taken along the line II - II in Figure 1,

Figure 3 is a bottom view illustrating the same application, with the bottom plate of a casing removed,

Figure 4 is a lateral cross section showing the centrifugal clutch according to the present invention,

Figure 5 is a front view illustrating a lid member for tightly sealing one end of the centrifugal clutch,

Figure 6 is a longitudinal cross section of the lid member,

Figure 7 is a front view showing a clutch body of the centrifugal clutch,

Figure 8 is a plan view of the clutch body,

Figure 9 is a front view showing a clutch drum of the centrifugal clutch,

Figure 10 is a cross-sectional view taken along the line X - X in Figure 9,

Figure 11 is a front view showing a permanent magnet

to be used in the centrifugal clutch; and

Figure 12 is a front view illustrating another embodiment of the clutch drum of the centrifugal clutch.

The present invention will now be described hereinafter in more detail.

The centrifugal clutch of the present invention comprises a clutch drum loosely rotated relative to a rotary drive shaft, a clutch body loosely fitted within the clutch drum and an engaging permanent magnet retained in a retaining hole bored in the clutch body so as to be loosely movable in the radial direction. The rotary drive shaft which serves as a magnetic substance is inserted into the clutch body so that the clutch body may be driven. When the clutch body is not driven, the permanent magnet attracts the rotary drive shaft and is accommodated within the retaining hole. When the clutch body is being driven, the permanent magnet is released from the rotary drive shaft by the centrifugal force of the clutch body, projects toward the inner wall of the clutch drum and is engaged with an engaging protuberance provided in the clutch drum, with the result that the rotation of the clutch body is transmitted to the clutch drum.

This centrifugal clutch is applicable, for example, to an actuator for driving a motor for use in a door locking apparatus in an automobile as illustrated in Figure 1 through Figure 3.

In an actuator capable of remotely manipulating a door locking apparatus to lock or unlock an automobile door by use of a motor producing clockwise and counterclockwise rotations and also capable of manually operating the door locking apparatus, when the door locking apparatus is manually operated, the manual operation interferes with the motor and forces the motor to be rotated and, as a result, the manual operation is not smoothly effected. To eliminate this adverse problem, a clutch is used and

serves to disconnect the motor and the door locking apparatus when the motor stops its rotation.

A motor 2 is disposed on one end side within a casing 1 which has a cover plate 11 and a bottom plate 12 fastened to each other with screws 13. A rotary drive shaft 21 extends from the motor 2 toward the other end side of the casing 1. To the rotary drive shaft 21 is attached a centrifugal clutch 3.

The centrifugal clutch 3 comprises, as illustrated in Figure 4, a clutch drum 4 supported by admitting therein the rotary drive shaft 21 so that the leading end of the rotary drive shaft 21 is loosely rotated around the centre of the clutch drum 4, a clutch body 5 loosely fitted within the clutch drum 4 and driven by the rotary drive shaft 21, an engaging permanent magnet 6 retained by the clutch body 5 so as to be loosely movable in the radial direction, and a lid member 7 allowing itself to be loosely rotated relative to the rotary drive shaft 21 and tightly sealing one end of the clutch drum 4 having the clutch body fitted loosely therein.

A bevel gear 47 is integrally formed with the rear surface of the clutch drum 4 and engaged with a movement transmission bevel gear 8 which rotates round an axis of a direction substantially at right angles relative to the axis of the rotary drive shaft 21. The movement transmission bevel gear 8 is provided on the rear surface thereof integrally with a spur gear 81 which is engaged with a sector gear 9. The sector gear 9 is firmly attached to a swing shaft 10 rotatably supported by the casing 1. To the swing shaft 10, a swing lever 10a is firmly attached.

The actuator is installed at a position suitable for operating the door locking apparatus by means of bolts to be inserted into bolt fitting apertures 14. The leading end of the swing lever 10a is connected to the door locking apparatus through the medium of a link mechanism (not

shown). Electric wires 15 are connected to a source of electric power.

The centrifugal clutch 3 will be described in more detail with reference to Figure 4 through Figure 11.

The clutch drum 4 is formed, as illustrated in Figures 9 and 10, in the shape of a cylinder having an empty space 41 opening at one end thereof. The opening end of the empty space 41 is provided with a groove 42 for fitting the lid member 7 therein. The cylindrical clutch drum 4 has large inner diameter portions 43 and engaging protuberances 44 symmetrically protruding inwardly from the large inner diameter portions 43. The rear wall 45 of the clutch drum 4 has an insertion hole 46 bored at the centre thereof for loosely fitting and supporting therein the leading end of the rotary drive shaft 21. A bevel gear 47 is formed on the embossing surrounding the insertion hole 46 on the rear surface side of the rear wall 45. An axial projection 48 protrudes from the centre of the bevel gear 47 and is supported by the cover plate 11 of the casing 1.

The clutch body 5 is formed, as illustrated in Figures 7 and 8, in the shape of a cylinder having holes 51 bored therein for reducing the weight of the clutch body itself and has an outside diameter slightly smaller than the inside diameter of the clutch drum 4 defined by the engaging protuberances 44. The clutch body 5 is thus loosely fitted within the clutch drum 4 with the slight distance left therebetween. The clutch body 5 has a shaft hole 52 of a substantially semilunar cross section bored at the centre thereof for inserting and fitting therein the rotary drive shaft 21 of the same cross section and is driven by the rotary drive shaft 21. Further, the clutch body 5 has a retaining hole 53 which opens outwardly in the radial direction from the shaft hole 52 for loosely movably retaining therein an engaging permanent magnet 6 as illustrated in Figure 11. The engaging permanent

magnet 6 attracts the rotary drive shaft 21 as a magnetic substance and is accommodated within the retaining hole 53 when the clutch body 5 is in a standstill state and, when the rotary drive shaft 21 is rotated in a clockwise direction or a counterclockwise direction at a given number of rotation, the engaging permanent magnet protrudes from the retaining hole 53 toward the inner wall of the clutch drum 4 by the centrifugal force larger than its attracting force exerted onto the rotary drive shaft 21 and has the leading end thereof engaged with one end of the engaging protuberance 44 of the clutch drum 4. The engaging permanent magnet in this embodiment is required to have a length large enough not to be released from the retaining hole 53 when it is engaged with the engaging protuberance 44 and to exhibit considerable mechanical strength.

The clutch body 5 is inserted into the clutch drum 4 and the lid member 7 as illustrated in Figures 5 and 6 is fitted in the groove 42 of the clutch drum 4. The lid member 7 has an insertion hole 71 bored therein for loosely fitting therein the rotary drive shaft 21.

Now, the function of the centrifugal clutch according to the present invention will be described hereinafter.

When the rotary drive shaft 21 of the motor 2 is in a standstill state, since the engaging permanent magnet 6 attracts the rotary drive shaft 21 and is accommodated within the retaining hole 53 of the clutch body 5, the clutch body 5 is kept in a state wherein it is loosely rotatable relative to the clutch drum 4 and does not transmit any movement to the clutch drum 4. When the door locking apparatus is manually operated, in this state, this manual operation causes the swing lever 10a to be swung and the resultant movement to be transmitted successively to the sector gear 9, spur gear 81, bevel gear 8, bevel gear 47 and clutch drum 4. Even though the clutch drum 4 is rotated in consequence of the successive

transmission of movement, it is loosely rotated round the clutch body 5 because the aforementioned state is maintained. In other words, the rotation of the clutch drum 4 is not transmitted either to the clutch body 5 or to the motor 2.

When the door locking apparatus is operated mechanically, i.e. by means of the motor 2, a switching operation for either locking or unlocking the door causes an electric current to be supplied to the motor 2 and the rotary drive shaft 21 to be rotated in the direction corresponding to the switching operation. When the rotary drive shaft 21 is rotated at a given number of rotation, the centrifugal force generated becomes larger than the attracting force of the engaging permanent magnet 6 to the rotary drive shaft 21 and causes the engaging permanent magnet 6 to loosely move within the retaining hole 53, protrude from the retaining hole 53 toward the inner wall of the clutch drum 4, come into contact with and slide on the large inner diameter portion 43 of the clutch drum 4, and engage with one end of the engaging protuberance 44. As a result, the rotation of the clutch body 5 given by the motor 2 is transmitted successively to the clutch drum 4, bevel gear 47, bevel gear 8, spur gear 81 and sector gear 9 and, consequently, the swing lever 10a is swung either rightwards or leftwards and causes the door locking apparatus to be operated through the medium of the link mechanism. Denoted by 16 in Figure 3 is shock-absorbing means for receiving the sector gear 9 at the opposite extremities of the swinging movement of the sector gear 9.

Figure 12 illustrates another embodiment of the clutch drum according to the present invention. A clutch drum 4a in this embodiment has a single engaging projection 44a formed on the inner wall thereof and has large inner diameter portions 43a formed in the vicinity of the opposite lateral ends of the engaging projection 44a and

the minimum diameter portion 49 formed on the inner wall of the clutch drum 4a opposed to the centre of the engaging projection 44a so that the inner diameter of the clutch drum is gradually decreased from the large inner diameter portions 43a toward the minimum diameter portion 49. When the engaging permanent magnet 6 protrudes toward the inner wall of the clutch drum 4a, in this embodiment, there is few possibility of the engaging permanent magnet 6 protruding directly toward the large inner diameter portion 43a. The engaging permanent magnet 6, at first, protrudes toward the portion in the vicinity of the minimum inner diameter portion 49, then comes into sliding contact with the portion and continues its sliding movement toward the large inner diameter portion 43a. That is to say, since the projecting stroke of the engaging permanent magnet 6 becomes large gradually from the vicinity of the minimum inner diameter portion 49 toward the large inner diameter portion 43a, the clutch drum 4a in this embodiment has an advantage that the noise generated when the engaging permanent magnet 6 protrudes toward the inner wall of the clutch drum 4a can be reduced.

According to the present invention, as described above, since a permanent magnet is used as an engaging member which fulfils its function when a centrifugal clutch is in motion, there can be provided a centrifugal clutch simple in construction, capable of reducing the number of the component parts, excellent in durability, inexpensive in manufacturing cost and operable with high precision.

Further, the present invention enjoys advantages that it is possible to obtain high waterproofing and dust-preventing effects where the clutch drum is tightly sealed with the lid member, to obtain immediate engagement between the clutch drum and the clutch body during the operation of the centrifugal clutch where a number of engaging protuberances are provided on the inner wall of

the clutch drum, and to cause the actuator to be operated smoothly because the speed of rotation is reduced by use of a plurality of gears. Thus, the present invention makes a great contribution to the field of this art.

CLAIMS

1. A centrifugal clutch comprising, in combination, a clutch drum (4) loosely rotated relative to a rotary drive shaft (21) serving as a magnetic substance, and provided with large inner diameter portions (43) and engaging protuberances (44) inwardly projecting from said large inner diameter portions (43); a clutch body (5) loosely fitted within said clutch drum (4), admitting insertion and fitting of said rotary drive shaft (21) to be driven by said rotary drive shaft (21), and provided with a retaining hole (53) opening radially from the centre thereof toward the inner wall of said clutch drum (4); and an engaging permanent magnet (6) loosely movably retained in said retaining hole (53), said engaging permanent magnet (6) being accommodated within said retaining hole (53) by its magnetic attraction to said rotary drive shaft (21) when said clutch body (5) is in a standstill state and, when said clutch body (5) is in a driven state, being caused to protrude toward the inner wall of said clutch drum (4) by means of the centrifugal force generated and to be engaged with one of said engaging protuberances.

2. The centrifugal clutch according to claim 1, further comprising a lid member (7) tightly sealing one end of said clutch drum (4) which has said clutch body (5) fitted loosely therein and allowing itself to be loosely rotated relative to said rotary drive shaft (21), whereby waterproofing and dust-preventing effects of the centrifugal clutch are highly enhanced.

3. The centrifugal clutch according to any of claims 1 and 2, wherein said clutch drum has the inner wall thereof provided with an engaging projection (44a), large diameter portions (43a) between which said engaging

projection (44a) intervenes and a minimum diameter portion (49) opposed to the centre of said engaging projection (44a), and has the inner diameter thereof decreased gradually from the large diameter portions (43a) toward said minimum diameter portion (49).

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FIG. 1

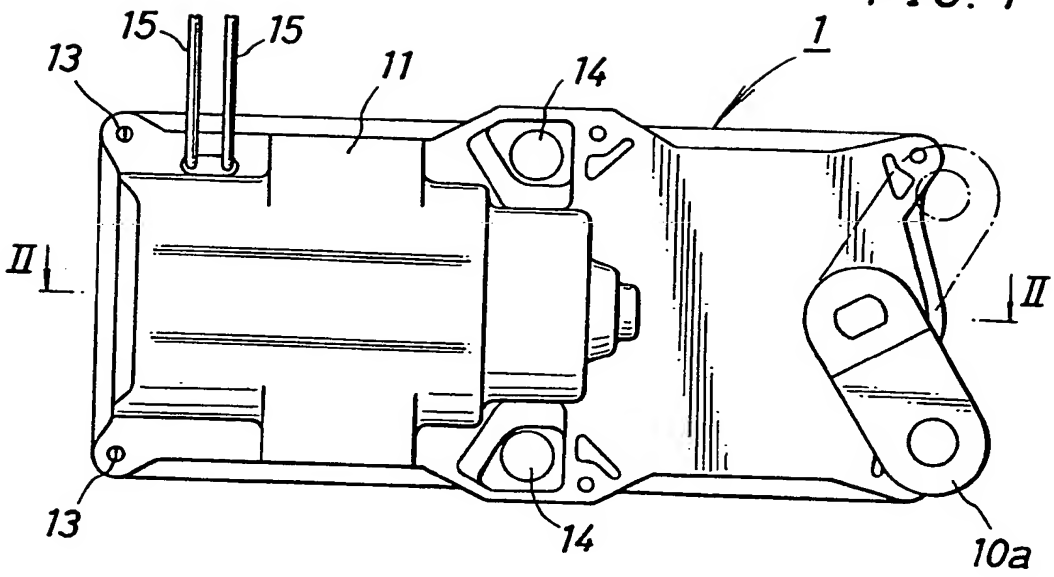

FIG. 2

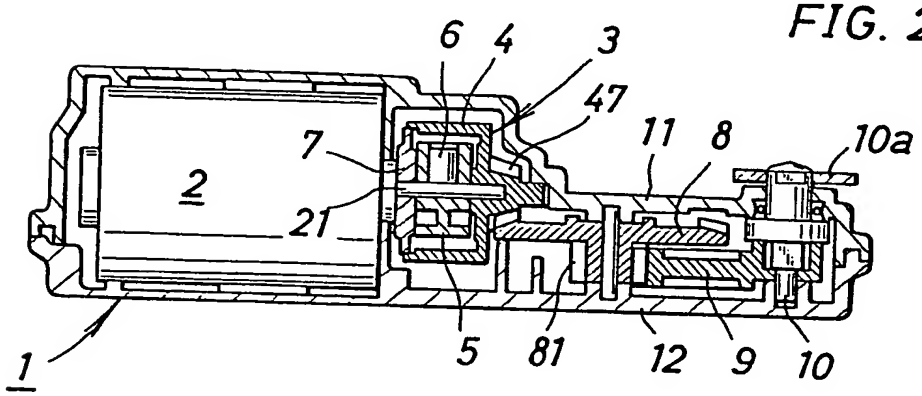

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FIG. 3

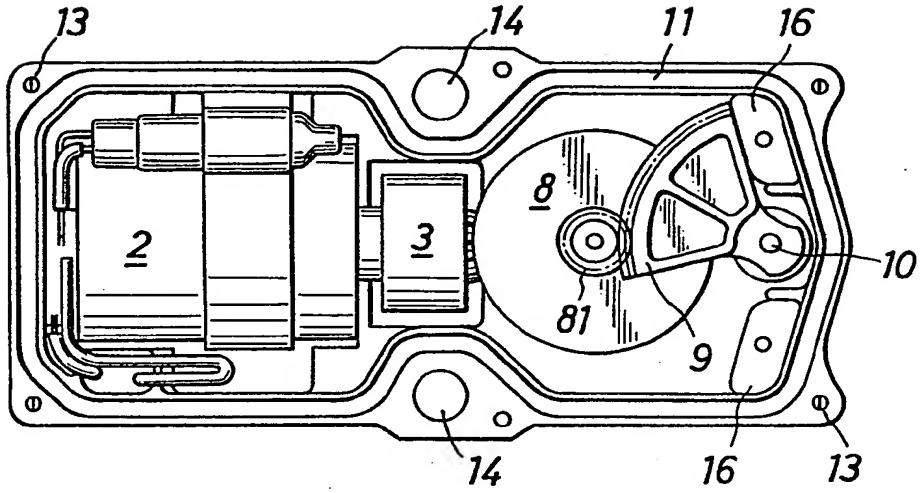

FIG. 5

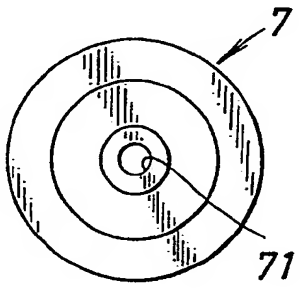

FIG. 4

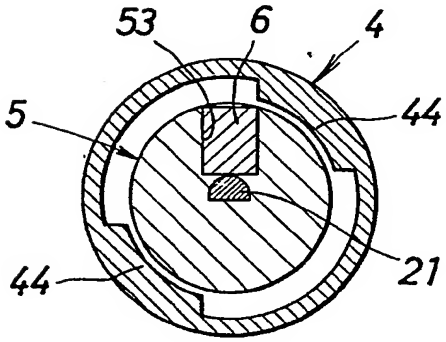

FIG. 6

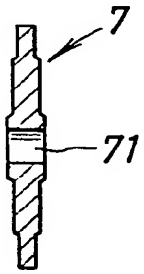

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FIG. 7

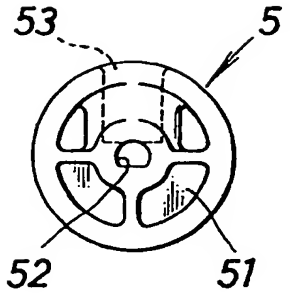


FIG. 8

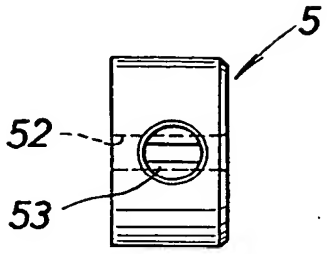


FIG. 9

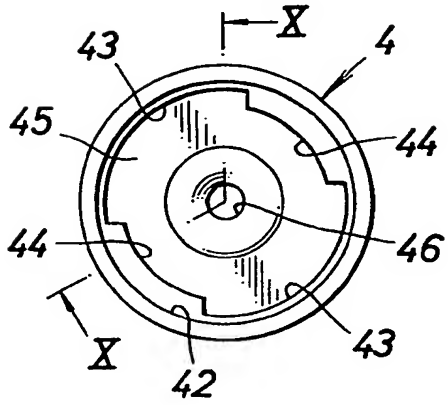


FIG. 10

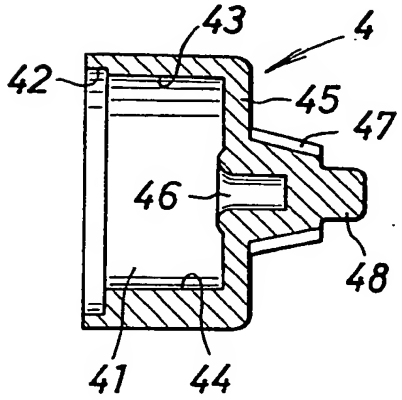
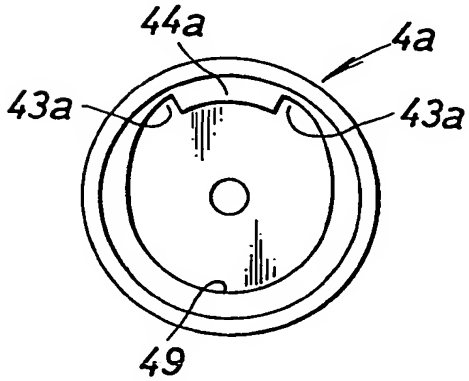


FIG. 11

FIG. 12



European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 82 73 0062

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Y	DE-C- 63 920 (HOLLER'SCHEN CARLSHUTTE) *The whole document*	1,3	F 16 D 43/16 E 05 B 65/42
Y	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 9, no. 1, June 1966, pages 76,77, New York (USA); D.GADBURY et al.: Centrifugal clutch'' *The whole document*	1,3	
Y	GB-A- 647 410 (BENTLEY) *Page 2; figures 1 to 3*	1,3	
A	US-A-2 217 495 (PRESTON)		

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

F 16 D 43/00
F 16 D 27/00
B 60 R
E 05 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	03-08-1982	BALDWIN D.R.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
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1/3

FIG. 1

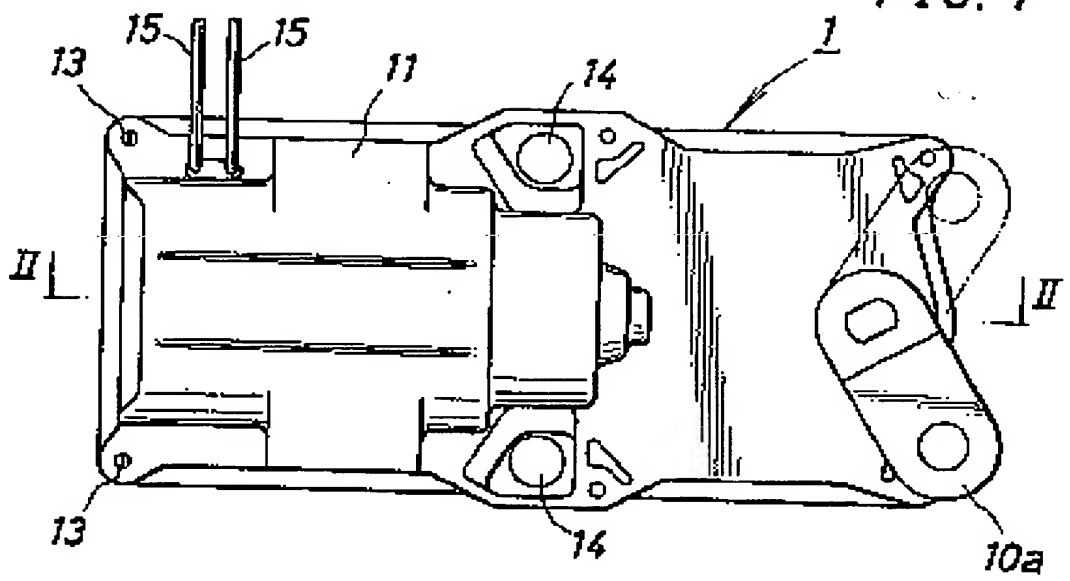

FIG. 2

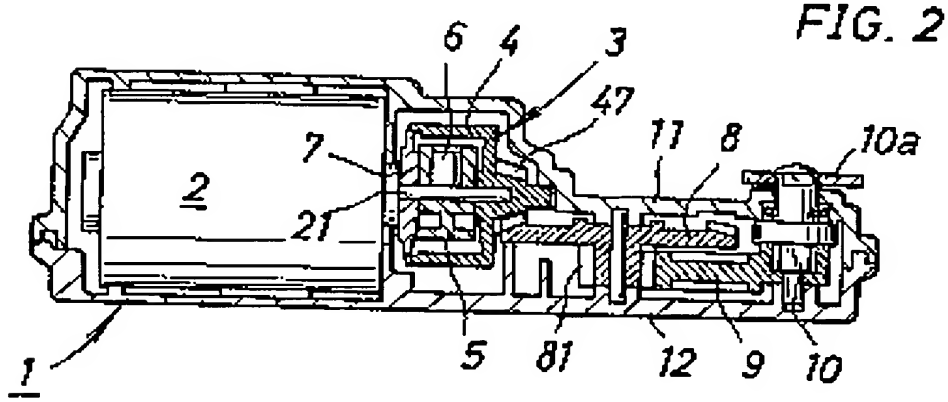

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FIG. 3

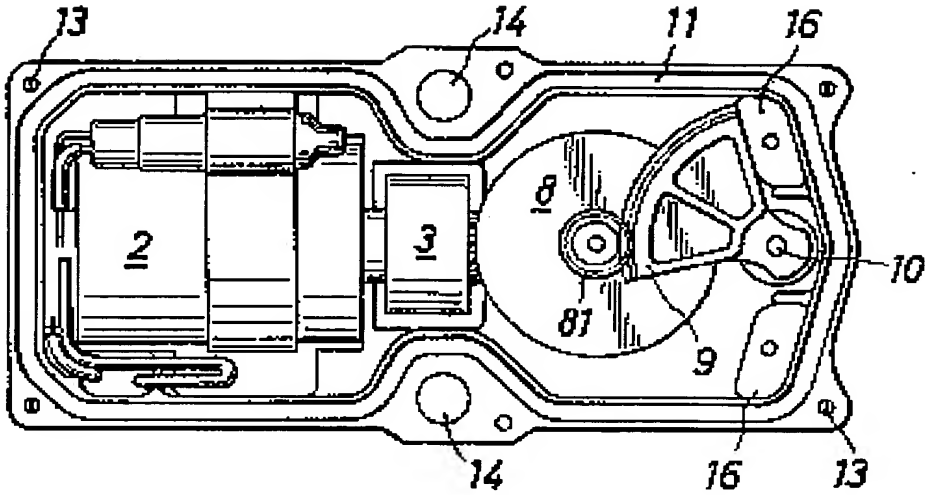

FIG. 4

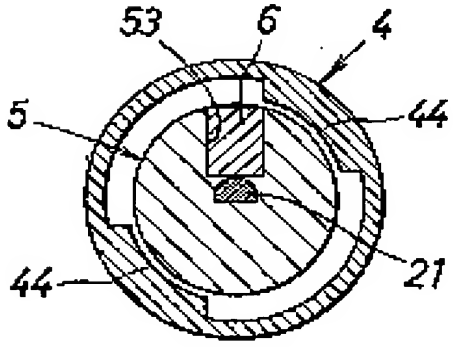

FIG. 5

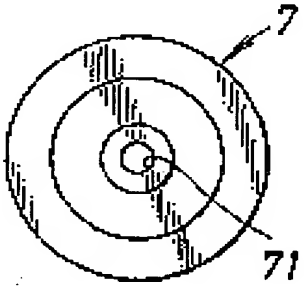

FIG. 6

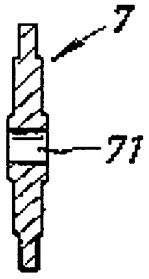

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FIG. 7

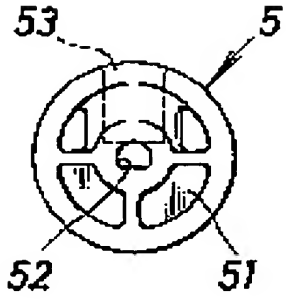

FIG. 8

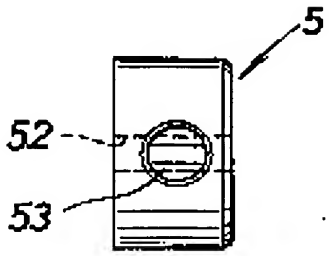

FIG. 9

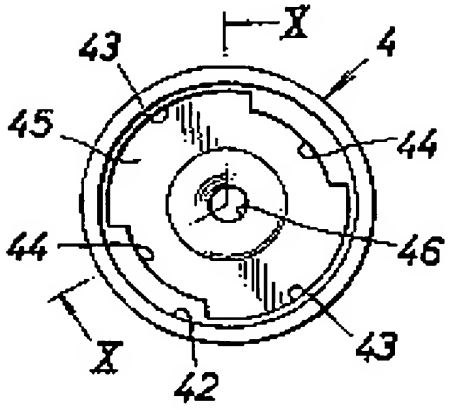

FIG. 10

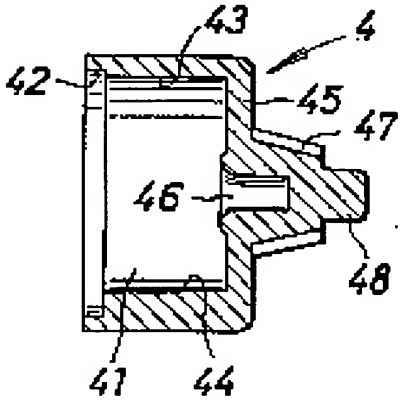

FIG. 11

FIG. 12